



Lupin Bioeconomy
Development

Lupinus mutabilis for Increased Biomass from marginal lands and value for BIOrefineries



www.libbio.net

About the project

LIBBIO is a European research project on the Andean Lupin (*Lupinus mutabilis*, tarwi). Lupin has the ability to fix nitrogen, mobilise soil phosphate and has low nutritional requirements for cultivation.

Varieties will be chosen that give high yield of green silage or high yield of seeds which contain 20% oil, more than 40% protein. The remaining materials are carbohydrates, mainly oligosaccharides which can be characterized as “prebiotics”. Andean Lupin will be grown as summer crop in N-central Europe and as winter crop in Mediterranean conditions.

Pre-industrial processing is developed and optimized for the lupin, properties of the different fractions are analysed, their advantage for different industrial use is evaluated, and a few products are developed as an example. Social and environmental impact will be evaluated as well as techno-economic viability and effect on farm and biorefinery income.

The project started on 1st October 2016 and is expected to finish on 30th September 2020. The estimated project cost is 5 million euro.



From the consortium meeting in Utrecht, Sept. 2017



Early stage cropping inspection in Iceland

Concept

The overall concept of the project is to develop and optimize an Andean Lupin breeding and cropping programme plus the primary processing pipelines while at the same time developing high value-added consumer or business-to-business products, thereby reducing lead times for products to reach the market.

Processing will result in new oil, protein, alkaloid and soluble fibre based consumer and industrial products. Parallel development of all the elements of the supply chain will generate market demand by the time the first Andean Lupin varieties adapted to EU conditions are available, thereby accelerating demand and stimulating production within the timeframe needed for Europe to reduce imports and enhance self-sufficiency in oilseed.

The project has adapted a supply chain approach by starting upstream with crop genetics, breeding, cropping, raw material processing, food and non-food product applications and ending down-stream with techno-economical evaluations (including market and consumer perspectives) parallel with environmental and sustainability evaluation.



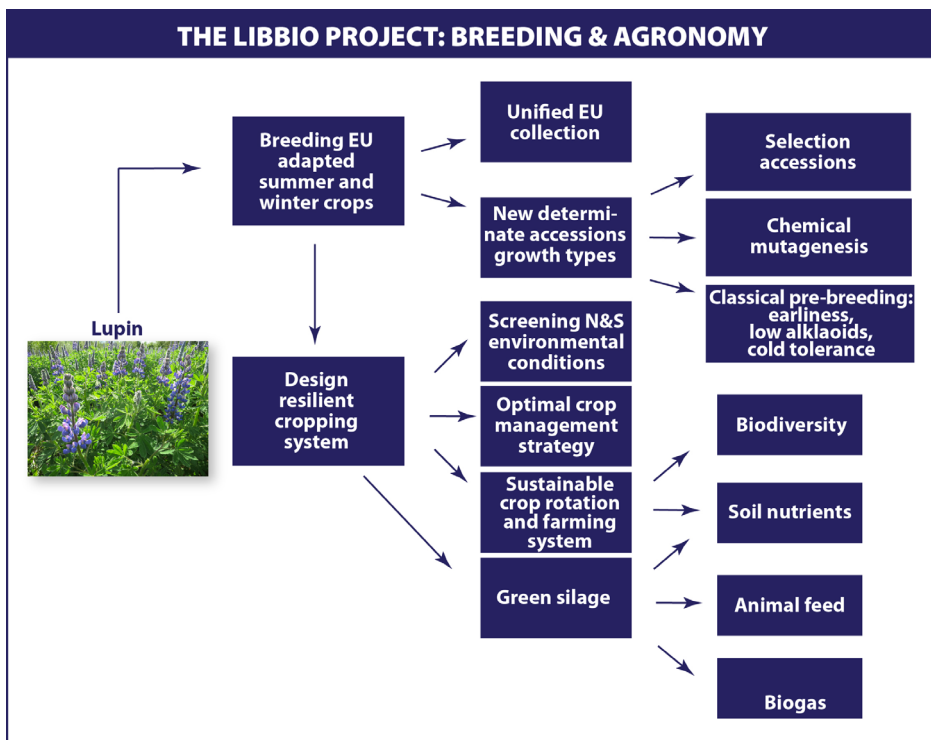
Ripening seed in Austria, August 2017



Harvesting in Romania, 2017

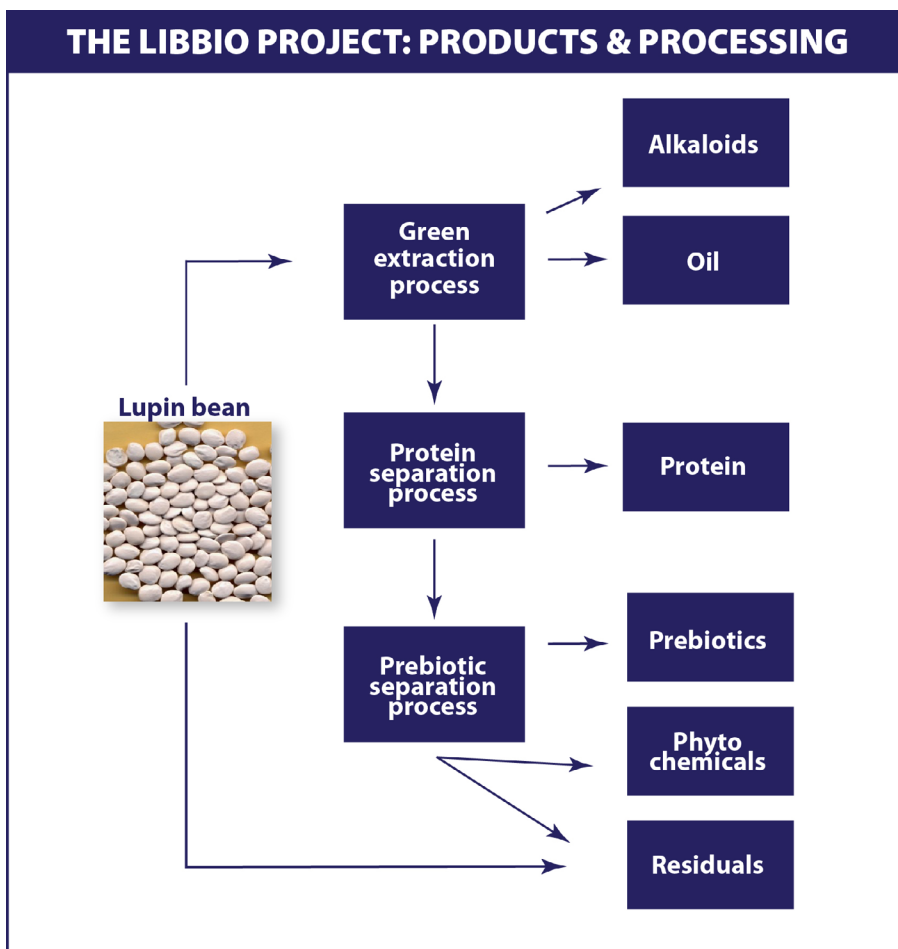
The project will use a non-GMO approach for breeding thereby satisfying consumer and producer requirements for GMO-free products. Modern molecular technologies will be used to accelerate traditional breeding techniques.

Trans-disciplinary activities will be encompassed across the project within a “stakeholder-platform” to promote and facilitate interactions (e.g. via interactive workshops for knowledge circulation) among project participants and representatives of larger companies (non SME), NGO’s, consumer organisations and farmer associations.



New oil crop varieties and green extraction processes for oils and alkaloids will be developed to demonstration level by the end of the project. New products will be prototyped and be ready for further development by participating SME's and companies in the stakeholder board.

The main focus is on non-food applications of lupin products and on supporting and enhancing the European bio-economy. However, high-value food applications will also be developed to ensure the most valuable use of the whole plant in a cascading approach.



Objectives

The project objectives are to develop consumer food, feed, non-food and bio-energy products from Andean Lupin varieties (*Lupinus mutabilis*) adapted to European farming conditions by applying bio-refinery cascading principles for crop value creation and modern crop breeding technologies.

Further objectives of the project are to increase crop yield and harvest index and to accelerate supply chain development via a consumer-driven approach for developing high value-added food and non-food products by applying state-of-the-art solvent-free technology for raw material processing.



L. mutabilis seeds from Greek trials



Supercritical extraction trials at Hanze UAS



Breeding work at Lusosem (Pt)



Lipsticks and lipgloss containing LIBBIO lupin oil from Color&Brain (NL)

Project work

Project work is divided into work packages and tasks:

1. Breeding

- Unified EU collection
- New accessions with determinate growth
- Breeding of new varieties

2. Cropping

- Screening of lines of *L.mutabilis* under European conditions.
- Optimal crop management strategies
- Building sustainable crop rotations and farming systems
- Farmer field demonstrations

3. Pre-processing development

- Biomass disrupting processing technologies
- Biomass oil extraction/separation processing technologies
- Biomass protein extraction and separation processing technologies
- Extraction&separation processes for alkaloids and other compounds
- Characterization of fibre and lignocellulosic biomass

4. Application development

- Oil composition, properties and applications
- Protein composition, properties and applications
- Oligosaccharides, alkaloids and lecithins, properties and applications
- Additional applications of residual crop fractions
- Green silage

5. Sustainability, technical and economic viability assessment

- Soil regeneration
- Lupin advantages in biomass production on European marginal lands
- Techno-Economic viability
- Sustainability assessment

6. Exploitation and communication

- IPR Protection
- Dissemination of knowledge
- Advisory board operation
- Communication

7. Consortium management

- Collation of deliverables, milestones, and reports.
- Legal contracts, financial and admin management
- Organisation of project management and exploitation board meetings
- Organisation of, ethical and science responsibility aspects



LIBBIO communicates with stakeholders in different ways, such as when Hanze UAS and C&B introduced LIBBIO on Eco-farming field day in Frankenhausen (DE), June 2017

Project partners

Innovation Center Iceland

www.nmi.is



**Innovation Center
Iceland**

Innovation center Iceland (ICI) is the coordinator of LIBBIO.

ICI is a multi-functional R&D institute, also running a support system for innovations, entrepreneurs, business opportunities and starting companies.

ICI's main roles in LIBBIO are consortium management, use of proteins in non-food application and use of residuals from more valuable processing.

Hanze University of Applied Sciences

www.hanze.nl



**Hanze
University of Applied Sciences**
Groningen

Hanze University is technical and exploitation manager of LIBBIO.

Hanze University of Applied Sciences, located in the Netherlands, has more than 2,700 employees and over 25,000 students in the fields of life sciences, chemistry, technology, economics, health care, education and teacher training, social work, business management, fine arts, music and more. Hanze Research Centre Biobased Economy provides technological infrastructure for the project.

Hanze's main roles in LIBBIO are technical management, biorefinery process development and techno-economic viability assessment.

Wageningen University

www.wur.nl



Wageningen University (WU) in the Netherlands is one of the world's leading education and research centres in the plant, animal, environmental, agro-technological, food and social sciences, ranking from 2015 the best in the world in the field of agricultural and food science, in research and education.

WU's main roles in LIBBIO is leading the breeding of *L.mutabilis* of high yielding resource efficient *L. mutabilis* varieties for EU conditions, suitable for winter cropping in Mediterranean and summer cropping in north-central European conditions with modern breeding technologies.

The German Institute of Food Technologies

www.dil-ev.de



The German Institute of Food Technologies (DIL) has technical capabilities which span the full range of food technologies and beyond. 170 experts which tap new potentials every day and pave the way for innovations.

DIL's main role in LIBBIO is processing of lupine seeds for food applications, preprocessing of the biomass for increased process yield, green oil separation and assessment of biomass fractions for food.

Louis Bolk Instituut

www.louisbolk.org

LOUIS BOLK
I N S T I T U U T

The Louis Bolk Institute (LBI), located in the Netherlands, offers research, advice and development in the field of organic and sustainable agriculture, nutrition and health. Its strength lies in bringing different disciplines together, as exemplified by its broad range of researchers, including soil, plant and animal scientists as well as nutritionists and physicians.

LBI's main role in LIBBIO is to lead the development of sustainable low-input resilient cropping systems for *L.mutabilis*.

Color&Brain BV

www.colorandbrain.com



Color&Brain is a Dutch SME for private label innovation and invention, developing supply chains and new products and services based upon natural ingredients in the domains agro-food and cosmetics. Color&Brain has successfully developed supply chains from soil to consumer (supermarket) for innovative plant protein based products for meat analogues based upon high moisture extrusion. Color&Brain is owner of the natural herbal cosmetic brand ZoiY.

C&B's main role in LIBBIO is application assessment of biomass fractions. They will develop prebiotic lupin protein drinks, lupin peptide anti-aging cosmetics and lupin colour cosmetics.

Agencia Estatal Consejo Superior de Investigaciones Científicas

www.csic.es



CSIC

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

The Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC) is the largest public multidisciplinary research organization in Spain. CSIC collaborates with national and International universities, public RTD organizations, SMEs, companies and other institutions of a scientific/ technological nature.

CSIC´s main role is focused on practical issues related to the development of hybrid technology for facilitating the exploitation of heterosis and lupine cropping trials.

Instituto Superior de Agronomia

www.isa.ulisboa.pt



INSTITUTO
SUPERIOR D
AGRONOMIA
Universidade de Lisboa

Instituto Superior de Agronomia (ISA) is one of the faculties of the Universidade de Lisboa (University of Lisbon), Portugal. The core mission of ISA is Higher Education, Research & Development, and Technology Transfer in the scientific fields of Agriculture, Forestry and Natural Resources Engineering, Food Science and Engineering, Animal Production Engineering, Environmental Engineering, Biology, and Landscape Architecture. They have large *L.mutabilis* seed collection of about 800 accessions.

ISA´s main role in LIBBIO is breeding and cropping of *L.mutabilis*.

Agricultural University of Athens

www2.aua.gr



ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
AGRICULTURAL UNIVERSITY OF ATHENS

The Agricultural University of Athens (AUA) is serving agricultural sciences producing high quality graduates as well as scientific knowledge through basic and applied research. It has 42 fully equipped laboratories, a modern library, agricultural facilities (an arboretum, a vineyard, experimental fields, a flower garden, greenhouses, a cowshed, a sheep pen, a chicken coop, dairy installations, aquaculture tanks).

AUA's main role in LIBBIO is *L.mutabilis* cropping experiments.

The Soil Conservation Service of Iceland

www.land.is



LANDGRÆÐSLA
RÍKISINS

Soil Conservation Service of Iceland (SCSI) is combating desertification, sand encroachment and other soil erosion, promotion of sustainable land use and reclamation and restoration of degraded land. The work is on different levels, from policy making and research, to extension services and management of large- and small-scale reclamation projects.

SCSI's main role in LIBBIO is *L.mutabilis* cropping experiments in very marginal soil and difficult climate.

The University of Agricultural Sciences and Veterinary Medicine Iasi

www.uaiasi.ro



UNIVERSITATEA DE ȘTIINȚE AGRICOLE
ȘI MEDICINĂ VETERINARĂ
„ION IONESCU DE LA BRAD” DIN IAȘI
“University of Applied Life Sciences and Environment”

The University of Agricultural Sciences and Veterinary Medicine Iasi (IASI) in Romania is a specialized institution of superior agronomic and veterinary medicine training, financed by the state and having as fundamental mission the formation of agricultural, horticultural and animal husbandry engineers, economic engineers in agriculture and veterinary surgeons.

IASI's main role in LIBBIO is seed propagation and *L.mutabilis* cropping experiments.

Vandinter Semo Bv

www.vandintersemo.nl



Vandinter Semo Bv (VDS) is a Dutch seed producer. It is a breeding company involved in green manure and catch crops. VDS develops nematode-resistant varieties for mild climate zones. Lupine is of interest for them, an interesting crop for green manure and Nitrogen, comparable with other crops in the breeding program of VDS.

VDS's main role in LIBBIO is GWAS trials in cooperation with WU and *L.mutabilis* seed propagation.

**Lusosem – Productos Para
Agricultura Sa**
www.lusosem.pt



Lusosem markets and distributes seeds and plant protection products in Portugal, continuously seeking new solutions to national agriculture, as well as technical assistance to producer organizations and individual farmers. Adding value to the various ranks of the agricultural sector is a priority. Always in a sustainable and responsible manner.

Lusosem's main role in LIBBIO is *L.mutabilis* breeding, seed propagation and S-European winter cropping experiments.

**The Agricultural Research
and Education Centre
Raumberg-Gumpenstein**
www.raumberg-gumpenstein.at



The Agricultural Research and Education Centre Raumberg-Gumpenstein (AREC) in Austria is specialized for multifunctional farm systems and in developing complex landscape analysis in view of sustainable and efficient usage of natural potentials. It is the largest institution of the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.

AREC's main role in LIBBIO is producing lupine green silage for feeding and biomass production to assess the crop's beneficial effect on soil.

www.libbio.net

14 partners from 8 countries
Contributing to European bio-economy development



Horizon 2020
European Union Funding
for Research & Innovation



This project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 720726